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TABLE OF CONTENTS.

ROCK TERRACES ALONG THE STREAMS NEAR COLUMBUS, OHIO.[1]

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Several striking terraces of solid rock occur along the Scioto and Olentangy valleys in the vicinity of Columbus. Their character has been revealed in the physiographic study of the four local quadrangles, a study recently undertaken by the Geological Survey of Ohio. They are related to the problem of the post-glacial, and in some cases of the earlier development of these valleys; and it has seemed best to abstract from the material collected in the general study all the data bearing on the rock terrace problem.

So far as the quadrangles[2] involved are concerned, the terraces may be found, ten or more in number, at intervals along the Scioto from the property of the Insane Asylum west of Columbus to the northern boundary line of the area; and four or more, along the Olentangy from near Powell to the same line. There are also the beginnings of several rock terraces along the Big Darby valley.

The Scioto is on bed rock essentially all the way from the northern boundary to the old quarries north of the Asylum; and the Olentangy is similarly restricted from the same boundary on the north almost to Worthington, with occasional rock encounters from there to well within the city limits. The Big Darby has encountered rock at numerous well distributed points from just below where it enters our area to a point midway between

1. By permission of the State Geologist. Read before the Ohio Academy of Science, Granville, O., Nov. 28, 1908.
2. Dublin, Westerville, East Columbus, and West Columbus.

Georgesville and Harrisburg, and again at the latter place. The rock is all of Devonian age; two rather resistant limestones—Columbus and Delaware—and two much less resistant shales above—the Olentangy and Ohio.

Along the Olentangy from south to north the terraces may be described as follows.

West of Lewis Center and across the Olentangy, i. e., on the west side of the river, occurs a terrace about one mile north and south and from 200 to 300 yards wide. Its top stands 30–40 feet above the river, descends perceptibly toward the river, and over 20 feet from north to south. The top is quite uneven being rather heavily mantled with gravel, sand and fine alluvium in piles, ridges and bars. Altho the top is so thoroly covered, the terrace front presents solid limestone rock at several points along the river. The stream is undercutting at only one part of the front. In places, the bluffs at rear of the terrace are not sharp, but are old and gently inclined and support continuous cultivation. This condition of the bluff above the terrace is due to the age of the terrace and the considerable dissection to which the bluff has been subjected. Age of the terrace is attested not only by the condition of the bluff behind, but by the height of the terrace above the river. A flood plain occurs near stream level below the terrace most of the length of the front. Relation of this terrace top to rock structure below could not be made out owing to thick alluvial covering; but the same covering gives the terrace a certain cultural value. A church and cemetery, school-house and several good dwellings surrounded by productive farms may be found upon it, while several even larger nearby tracts are much less used.

One mile east of Hyattsville and across the Olentangy, a small rock terrace about three-eighths of a mile north and south and from a few yards to possibly 200 yards in width, descends gently toward the river with a slope of about 30 feet at widest part and with its edge not more than 20 feet above the water; almost bare rock, but partly covered with a thin sheet of alluvium. Rock is exposed along water's edge nearly the entire length. Terrace consists of the Delaware limestone, but its top is in no measure coincident with structure. A quarry has recently been opened in it.

Less than half a mile farther up the river on the same side, occurs a fine rock terrace over one and one-fourth miles long and about 300 yards wide at the broadest part, tapering considerably northward. The broad part is over one half mile long. The terrace front rises about 20 feet above the river, and the terrace top rises from the crest toward the bluff only about 20 feet which makes the form a very level-topped terrace. Rock is exposed continuously along the terrace front; and the river parallels it

closely today, but leaves a narrow flood plain at its base. Eastward behind the terrace rises a seventy-five foot bluff with a steep serrate front. Bluff largely of Ohio shale, occasionally exposed, with Olentangy covered at the base. Terrace consists of Delaware limestone apparently near top of formation, from which the shales have been swept together with a little Delaware. No quarries are opened in it, but a wagon road runs its entire length.

Across the river from the last and extending some distance farther north, occurs a low, long, narrow terrace. It has a length of one and one-half miles and a width of from 10 to 100 yards, and its front rises only 10–15 feet above the river. The top descends very gently toward the river and also descends 15–20 feet from north to south. A thin sheet of alluvium, but very little residual waste, on top. Many little runs descend across it, mostly on rock. Terrace front almost one continuous outcrop. Terrace is composed of Delaware limestone, and its top is a structural plain, being almost exactly coincident with the bedding planes. A good highway follows it from end to end.

This terrace descends at its southern end so low that high water rises over it, and it thus becomes flood plain for about one mile beyond the point where it is distinctly a terrace above the river. Thus treating flood plain and terrace together, since they are one, we have a rock platform two and a half miles long with its southern end only 5–6 feet above the stream, while its northern end is very nearly 30 feet above; and adding to this difference of 24 feet, the fall of the river in the same distance, about 20 feet, the terrace top is shown to descend about 45 feet in 2½ miles, and more than twice as much as the present stream falls. It follows therefore, that it must have been carved when the grade of the stream was much greater at this place than it is at present.

Passing now to the Scioto near the northern boundary of the area, there are three small terraces between Bellpoint and Rathbone. The first is on the west side a mile or more south from Bellpoint, and is almost 600 yards long and 200 yards wide. It stands 15 feet above the river; its surface descends eastward 15–20 feet toward the river and 10 feet southward down stream. It consists of limestone, and coresponds very closely with the bedding planes. A quarry opened in it.[3]

Across the river and lying just south of the above terrace is another of about the same size. It stands 25 feet above the river, descends gently southward but not toward the river. Two residences upon it.

Passing back to the west side and down stream a hundred yards, another long terrace may be found having a width of

3. Geol. of Ohio, Vol. II, p. 294.

100–200 yards. It is almost level each way, but descends about 10 feet toward the river. It stands 20 feet above the river, and a steep serrate bluff rises back of it. Its top is a structural plain. All three of the above terraces have nearly continuous rock fronts, and quarries have been opened in two of them.

Next down the river is the long narrow terrace on the west side just south of Rathbone. It is nearly one-half mile in length, descends 10 feet southward, but is almost perfectly level from back to front. It stands 20–25 feet above the river with much outcrop on terrace front. An excellent structural plain.

A mile farther down stream and on the east side may be found a rock terrace nearly one mile long and from 50 to 150 yards wide, 35–40 feet above the river, slopes gently toward the river, and descends 15–20 feet in its length. Only one other terrace studied is as high above the river as is this one.

Opposite Dublin occurs a strong rock terrace about three-fourths mile long and from 20 to 200 yards wide. Its top is 30–40 feet above the river and remarkably level, descending southward or down stream about 10 feet in its length. Some of the top is nearly bare; other parts are mantled with alluvium. Terrace front is a rock outcrop. A quarry long ago opened in the terrace near the Dublin bridge furnished building stone and lime, the latter being burned in kilns on the terrace.

On east side of Scioto just south of Hayden's run, may be found an interesting terrace over one-half mile long and 100–200 yards wide with its top full 40 feet above the river and very level. In northern half is much washed, calcareous gravel, but in southern half very little, usually none. Rock shows in terrace front in several places. Bluff rising behind the terrace is of limestone at base and deeply covered with drift. About in middle of bluff and 15–20 feet above the terrace top are fine glacial striae on limestone.[4] These striae are about 800 feet above sea level and 100 feet below the upland surface of the vicinity. Bed rock occurs in Slate run to the south and in another run to the north 25–50 feet above the striae. There seems to be a buried valley here but it can not have been as deep as the present Scioto valley. It must have been as deep as the top of the striated ledge and it may have been as deep as to the terrace top. The gravel being largely calcareous and only locally developed is probably of post-glacial origin. Of course, if it were laid as glacial outwash, the terrace top upon which it lies must represent the bottom of an older valley. No striae have been found on any of the rock terrace tops. The gravel has been opened and worked at two points, and a quarry and crusher are in operation in the southern part of the terrace.

4 Reported by W. C. Morse in 1906.

A magnificent rock terrace on the east side nearly one and one-half miles long lies between the Columbus Fishing Club pond on the north, and Fishinger's Bridge on the south. It narrows toward the north, but attains a width of a fourth mile in its central and southern parts. The terrace top averages about 70 feet above the river and has relief of 20–30 feet. The highest part is central, and the rock surface descends eastward as well as westward, northward as well as southward. South of the central higher part a depressed contour surrounds ten acres, and beyond the depression near the private road occurs a true sink hole. A little washed gravel is found on the terrace top, notably at the south, but in no abundance. Soil on the terrace top is otherwise thin, cherty alluvium. The terrace front is a continuous rock bluff, sometimes precipitous. The bluff behind this terrace is all of drift; and the rock below the drift is lower than in the terrace top, as is revealed by well records and by the absence of rock in the ravine east and southeast of the terrace. One well east of terrace goes almost 40 feet below the terrace before reaching rock. A large alluvial pan of modified drift built upon the terrace argues for its age.

By way of interpretation, it is suggested that before the last ice sheet overspread this region there was a valley lying eastward at this point from the present Scioto which had attained a depth within 30 feet as great as the present valley; that this valley became drift filled, and then the glacial drainage, and subsequently the present Scioto, took their course across the drift plain. After cutting down for some time and sweeping off the drift, the stream found itself on the rock of the terrace, a portion of the western side and bottom of the filled valley. Instead of sliding eastward into the old valley, the Scioto began down cutting in the rock on the western side of its valley, and thus carved the present gorge 70 feet deep below the terrace top. It has not been determined whether the sink hole mentioned, belongs with the post-glacial drainage system or not, but it is believed that it was formed before the last ice advance.

The largest terrace of all lies on the east side of the Scioto, begins about three-fourths mile down stream from the large storage dam and continues down stream 2½ miles or practically to the big bend in the river, where it turns eastward around Marble Cliff to receive the Olentangy. This terrace varies in width from a few yards to about 300 yards. At its upper end, it rises 25–30 feet above the river, but descends gently southward to less than 20 feet above. Some of the terrace top slopes toward the river, but north of Fifth Avenue a considerable area is quite level and coincides with the rock structure, the bedding planes, quite closely, and hence here might be called a structural plain. In some places, the terrace top is well mantled with

alluvium, but usually the layer of cherty clay is quite thin, and the rock is exposed in roadways, railroad cuts and brook beds. The terrace front is steep and practically continuous rock outcrop. The bluff to the east of the terrace contains Ohio shale which has been seen in several exposures, and below it the Olentangy, not exposed, but the drift cover above the shale is thick.

In some places, this terrace consists of two steps more or less definitely separated by a little scarp. There is rarely any flood plain below it before the river. It consists of Delaware and Columbus limestone, the former becoming very thin and finally wanting at the south end.

The most important cultural aspect of the terrace, no doubt, is the opportunity it affords for quarrying the limestone. The terrace front has been opened nearly its whole length, and one considerable quarry has been started in its top. The old Smith and Price quarry, several little old ones, and the present Casparis and at least one other small quarry are to be found in the terrace. Part of the terrace top is under cultivation every year, and a small portion is devoted to golf links. The Pennsylvania railroad finds on it an easy grade from the flood plain in West Columbus up to its bridge at Marble Cliff and across to the undissected upland on the west side.

Opposite the west end of Fifth Avenue, is a low rock terrace, the present flood plain 400–500 feet wide and three-fourths mile long. It stands about 15 feet above the river and bears much alluvium especially along its water front so that rock is rarely exposed.

Farther south and on the west side of the Scioto along the big turn toward the east, occurs the most southern rock terrace of this river. It is more than a half mile in length, a hundred yards in width, and stands 20 feet or more above the river. It has been so many times opened for quarrying and modified by erosion that details of its surface form are difficult to obtain. The T. and O. C. railroad swings across it, as also does the highway.

A few more rock terraces were found along the Big Darby. The first is two miles south of Georgesville on the west side, and is about one-fourth by one-eighth mile in size with its top 20–25 feet above the river. This is the only one along the Darby creek that is far above the water.

For two miles south of the intersection of Big Darby with the Columbus and Springfield electric line, a number of miniature rock terraces occur, rising 5–20 feet above the water. This stream has cut thru the drift mantle, but has only begun here and there to cut into rock, hence, it is in a much less advanced stage of terrace development than the two larger rivers. Its terraces are not large, and are never far above the water; but it seems probable that a time will come when the Big Darby will have so

far cut into the rock that its valley shall be ornamented with terraces as are its larger neighbors. Its problem will then, however, be somewhat complicated, if its alluvial terraces shall persist that long, for today the Big Darby has many fine terraces of this more ephemeral type.

In conclusion, a few facts and deductions may be noted.

1. The grade of the rivers has been reduced since the terraces were made. Almost every terrace top is nearer the river level at its downstream end than at the other. And further, an analysis of the slopes of the various terrace tops shows that the higher ones descend downstream most rapidly, and the lower ones but little faster than the present water level. The average fall of the present Scioto across the quadrangle is $6\frac{2}{3}$ feet per mile; that of the Olentangy is $5\frac{1}{2}$ feet per mile—bee line distances. The upper terraces fall 20 feet per mile and some of the lower ones about 10 feet per mile.

2. This relation just noted confirms a statement made earlier in the paper, that the terraces, with two possible exceptions, were made by the present streams. The same statement is further confirmed in the fact that all terraces descend southward or with the present drainage.

3. It has been pointed out that in harmony with the slight eastward dip of the rock and the customary streamward slope of the terrace tops, those on the west side are usually structural plains, while those on the east side are usually not.

4. The terraces are confined to country whose surface rock is limestone, or limestone with a very little shale cover. The shale alone seems not to be adapted to terrace formation. It might be added here that in one side stream good terraces were found consisting of Ohio shale from which the thick drift cover had been removed. The shale proving a much tougher material than the drift the stream has, to date, been unable to make nearly as wide valley in it as was made while still cutting in the drift above. Hence is found a large shale terrace symmetrically disposed on each side.

5. The terraces are of marked economic importance, offering good roadways above flood waters, good building sites above the fertile flood plains but not so far away as sites on the uplands must needs be. Springs frequently occur at the back side of the terrace, making them still more desirable for residences. Finally most of the quarries are in these terraces, because of the excellent opportunities to get at the rock.